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H231 H232 H233 H234 H245 H250 H251 H270
H272

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GB 1454394 A GB 1050386 A US 4474841 A
US 4158078 A US 3968348 A

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(54) Rigid plastics electric heater panel

(57) An electric heater comprises a heating element 10 encapsulated in a rigid plastics moulding 11. The element may be in the form of a flexible sheet and may comprise a substrate of electrically insulating material such as a woven glass-fibre mat 12, coated with electrically resistive material, such as a plastics material containing carbon particles. An aluminium plate (36, Fig 8) may be secured to one or both major surfaces of the moulding to increase the area of heat dispersion. A fan may blow air over six elements mounted in a casing (30).

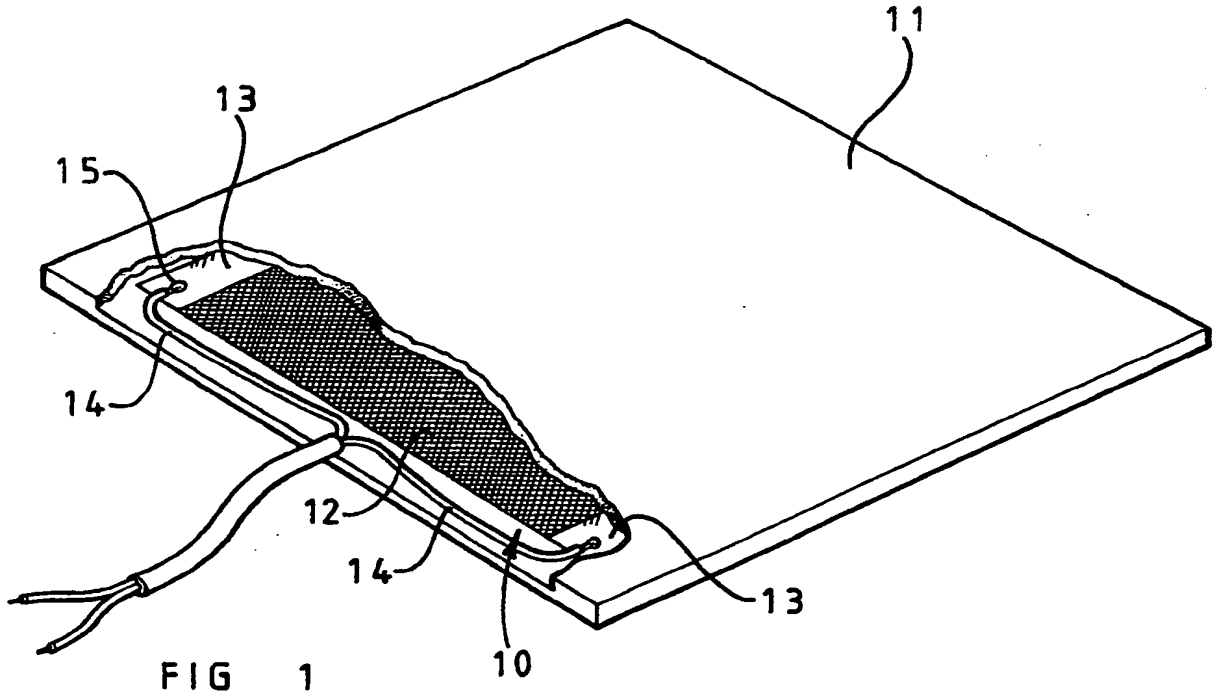

FIG 1

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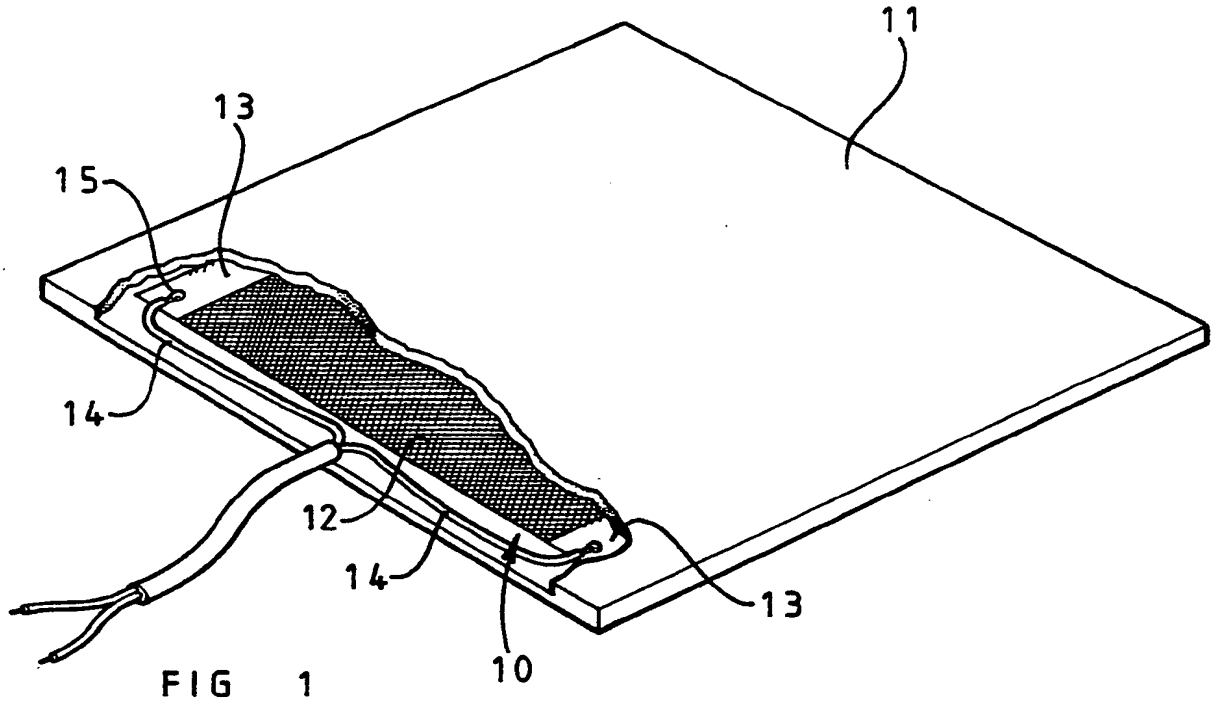


FIG 1

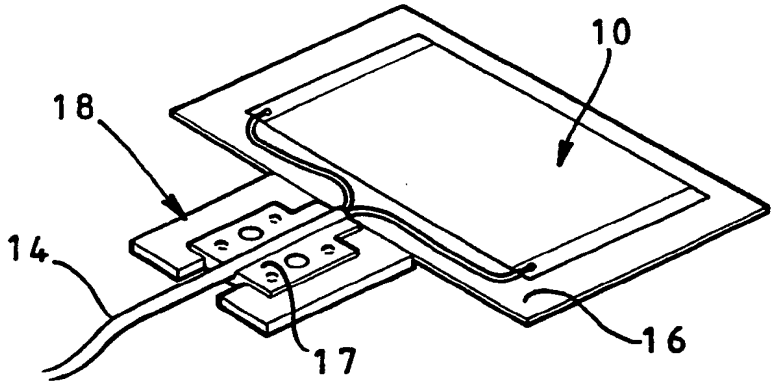
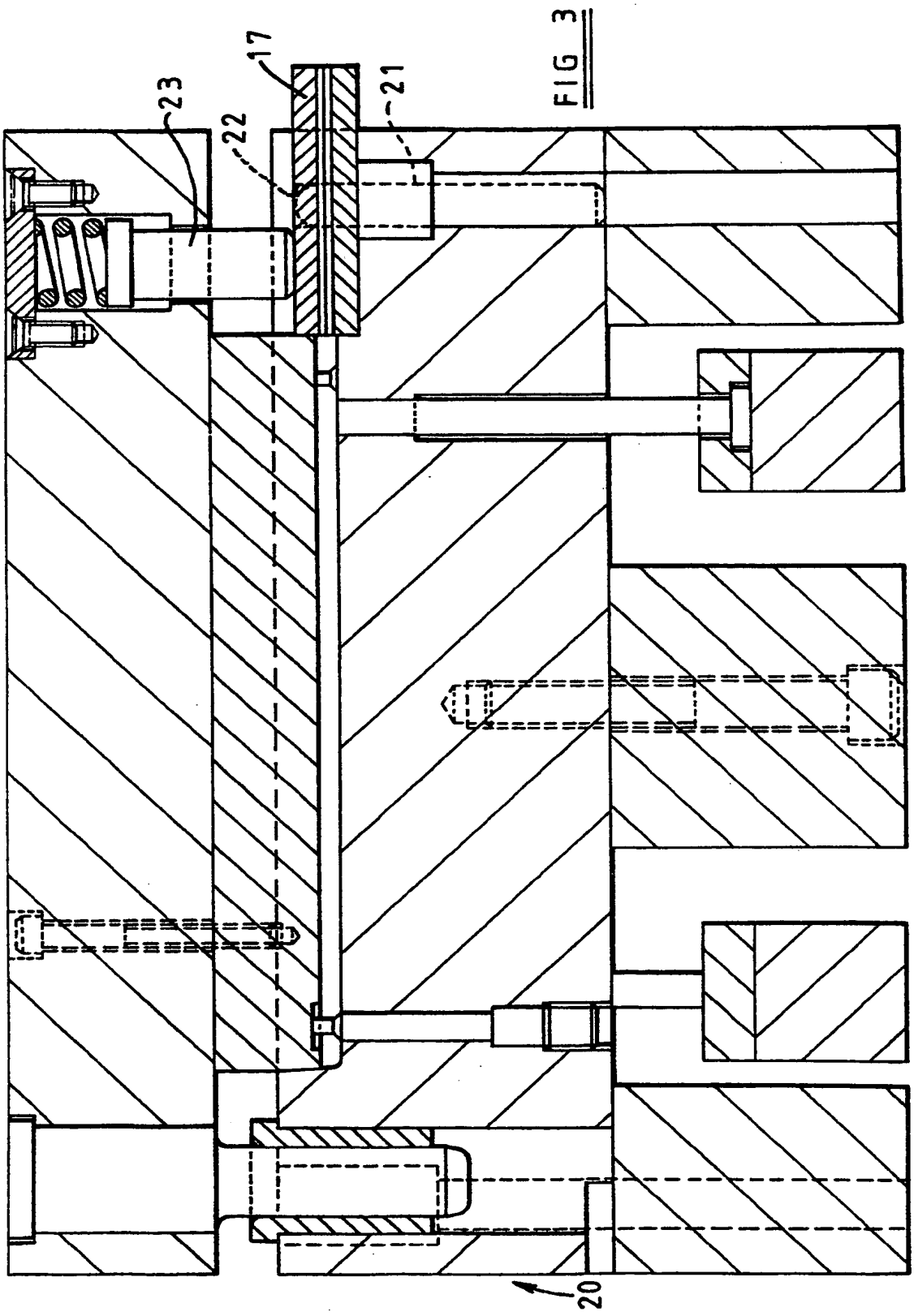


FIG 2

FIG 3



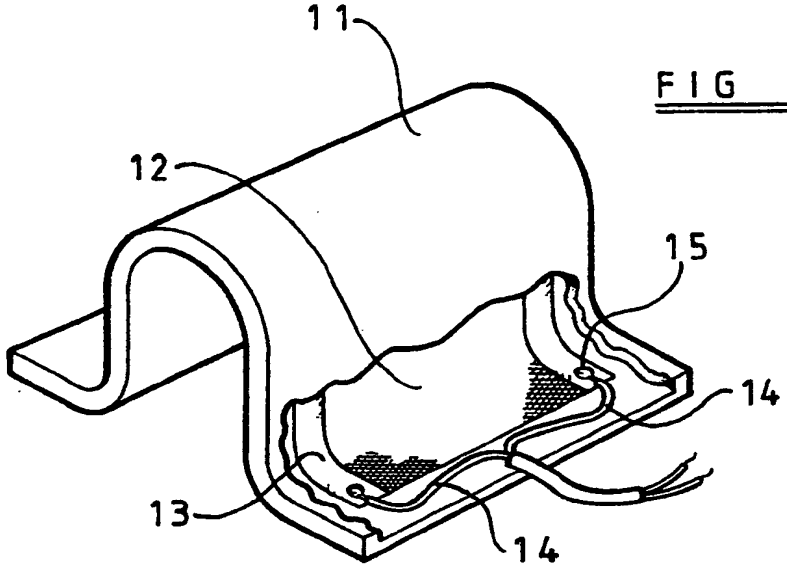


FIG 4

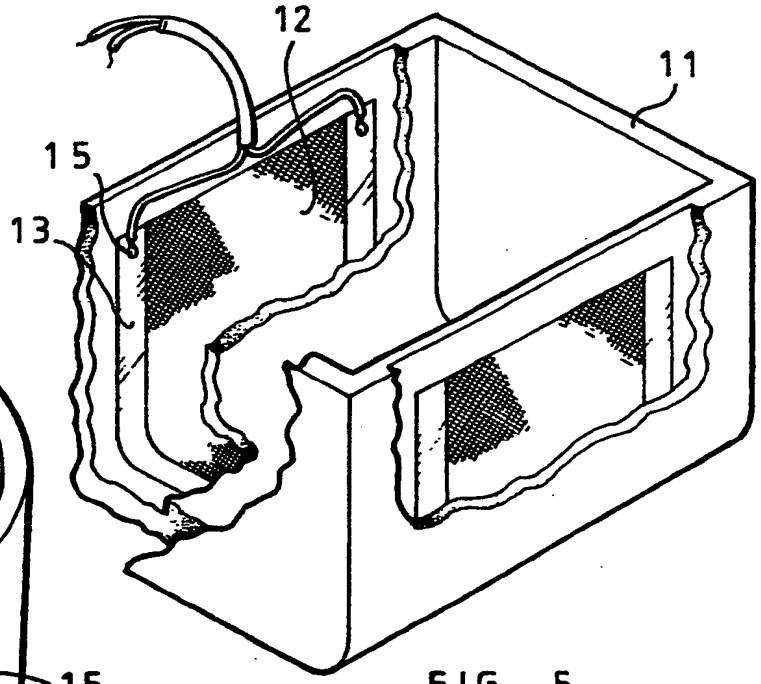


FIG 5

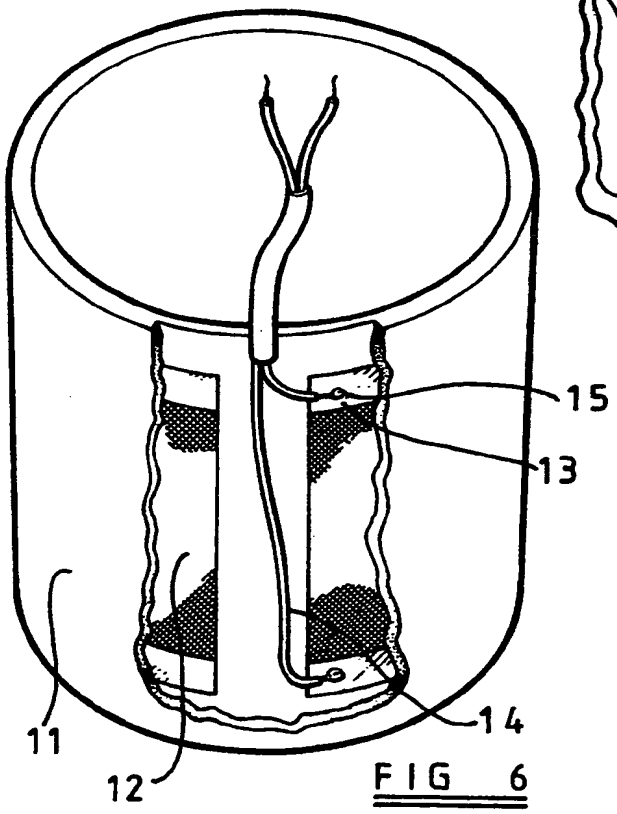
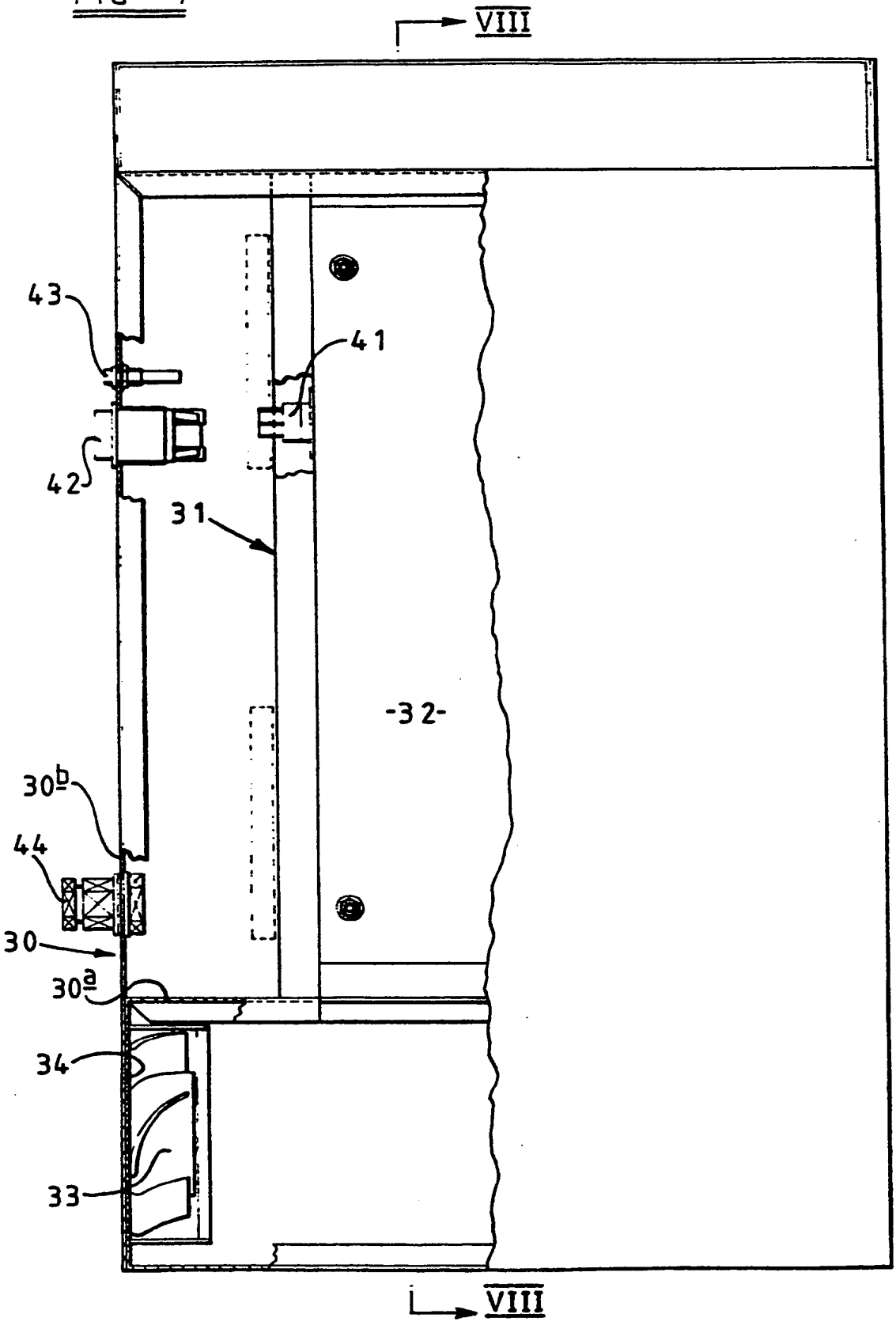


FIG 6

FIG 7



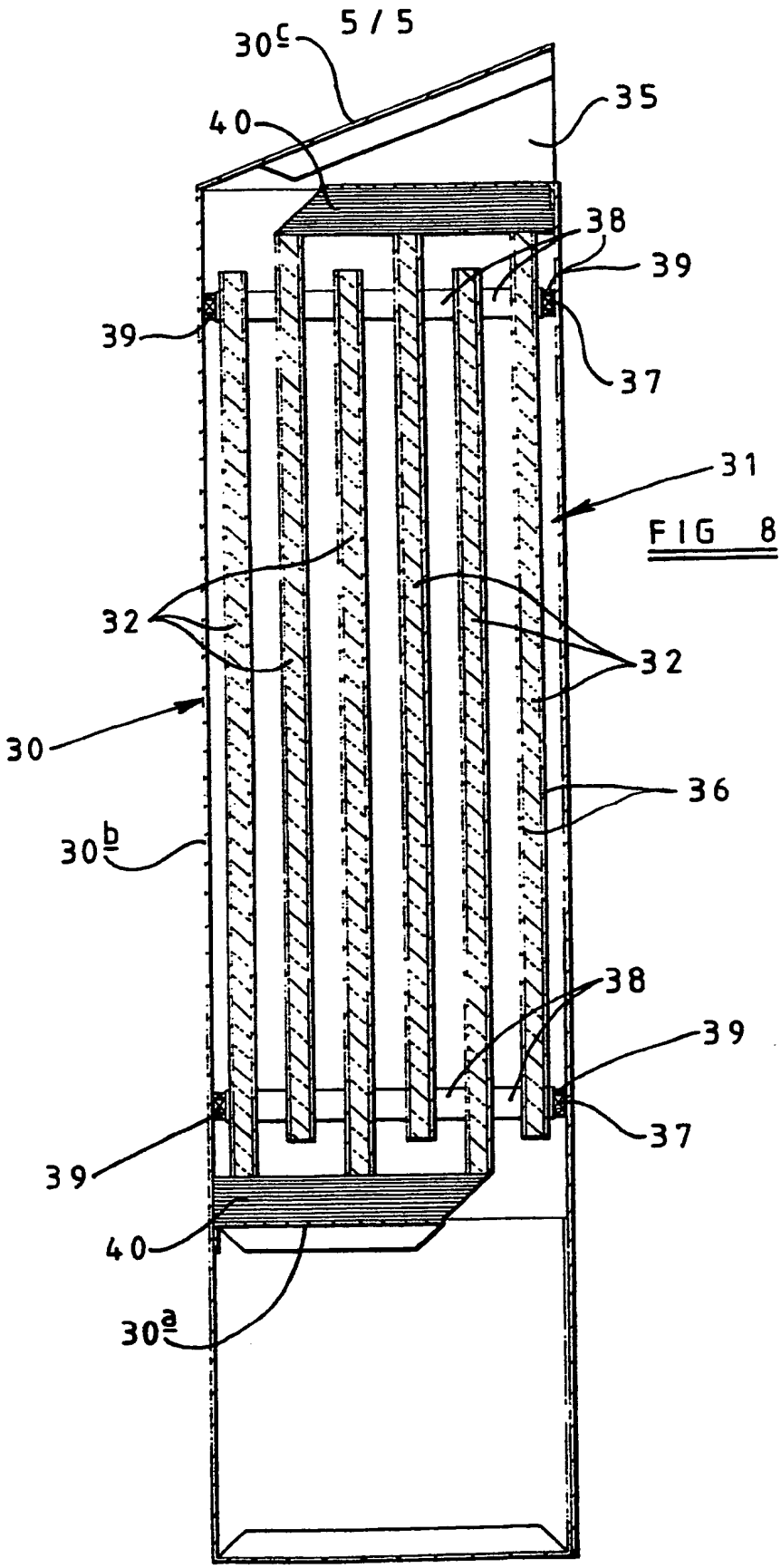


FIG 8

ELECTRIC HEATER & METHOD OF MAKING SAME

This invention relates to an electric heater and a method of making such a heater.

According to a first aspect of the invention there is provided an electric heater comprising a heating element encapsulated in a rigid plastics moulding and means for connecting the heating element to a source of electricity externally of the moulding.

Preferably, the heating element is in the form of a flexible sheet.

Preferably, the heating element comprises an electrically insulating substrate, such as a flexible woven mat, coated with electrically resistive material, such as a plastics (or other) material containing carbon particles. In this latter case, the resistivity of the electrically resistive material can be predetermined by the amount of carbon in the plastics material.

Preferably, the heating element is disposed in the rigid plastics moulding adjacent to a major external surface of the moulding, and typically is spaced not substantially more than about 2mm from said major surface of the moulding.

In many applications it will be desirable to arrange for the heating element to be substantially equi-distantly spaced from each of two opposite major external surfaces of the moulding in order to radiate heat from said two surfaces. However, in other applications it may be desirable to arrange for the heating element to be closer one major surface than the other so that one surface will radiate more heat than the other.

A metal plate may be secured to at least one of the major external surfaces of the rigid plastics moulding to increase the area over which heat is dispersed.

According to a second aspect of the invention there is provided a heating device comprising a casing, a plurality of electric heaters according to the first aspect of the invention, mounted in spaced relationship in the casing, and means for causing air to pass over the electric heaters.

Preferably there are at least three of said electric heaters and the spaces between adjacent pairs of electric heaters are connected together in series.

According to a third aspect of the invention,

there is provided a method of making an electric heater according to the first aspect of the invention, comprising the steps of:-

(a) placing the heating element between two sheets of a moulding compound, and

(b) subjecting the assembly comprising the heating element and the two sheets of moulding compound to a compression moulding step.

The invention will now be more particularly described, by way of example, with reference to the accompanying drawing, in which:

Figure 1 is a partly cutaway perspective view of a heater according to the first aspect of the present invention,

Figure 2 is a perspective view illustrating one step in the manufacture of a heater according to the third aspect of the invention,

Figure 3 is a side view of part of a compression moulding machine,

Figures 4 to 6 show alternative embodiments of a heater according to the present invention,

Figure 7 is a vertical section taken through part of one embodiment of a heating device according to the second aspect of the invention, and

Figure 8 is a sectional view taken along line VIII - VIII of Figure 7.

Referring to Figure 1 of the drawings, the heater shown therein is in the form of a panel and comprises a heating element 10 encapsulated in a rigid plastics moulding 11.

The heating element 10 is in the form of a flexible sheet and comprises a woven glass-fibre mat 12 provided with a resistive coating of plastics material containing carbon particles, and two copper ribbons 13 stitched or otherwise secured to opposite edges of the mat 12.

The heating element 10 also has wire or cable terminations 14 sheathed in rubber or pvc insulation and soldered as at 15 to respective copper ribbons 13 for connecting the heating element to a source of electricity.

In some circumstances, it may be desirable to

provide four spaced copper ribbons 13 on the mat 12 to avoid hot spots developing in the heating element 10. In this case, alternate copper ribbons will be electrically connected together.

The panel is typically about 4mm thick with the heating element 10 substantially equi-distantly spaced from each major external surface of the panel. It follows that the heating element 10 is within about 2mm of each major external surface of the panel. This is important if heat is to be radiated by both major surfaces as plastics material is a poor conductor of heat. There may however be applications in which it is desirable to radiate heat from only one major surface of the panel or to radiate more heat from one than the other surface. In this case, the heating element is arranged closer to the one surface.

The encapsulating process may be carried out by conventional moulding methods, including compression moulding, transfer moulding, injection moulding, casting, hand lay up G.R.P and extrusion moulding. Typically, however, the encapsulating process is carried out by compression moulding.

The encapsulating material may be any appropriate heat resistant plastics material, including both thermosetting and thermoplastics materials.

Typically, the encapsulating material is a thermosetting polyester but other plastics materials will also withstand temperatures of about 200°C without showing signs of degradation. It is desirable that the plastics material should also be impact resistant.

Certain polyester sheet moulding compounds supplied by DSM Compounds UK Limited, of 5 Civic Way, Ellesmere Port, South Wirral, have been found to be suitable. In particular, the sheet moulding compound sold under their grade no. 5520 has been found to be suitable when a flame retardant material is required and the sheet moulding compound sold under their grade no. 47-5710 has been found to be suitable when a chemically resistant material is required.

The plastics material of the resistive coating of the heating element 10 is typically a polyester based compound and the resistivity of the coating can be predetermined by the amount of carbon in the plastics material in order to tailor the heating element 10 to give specific watt densities. At given electrical input values, this will determine the maximum attainable temperature of a given heater and theoretically it is possible to produce heating elements which will work on any specific a.c. or d.c. voltage.

The maximum temperature attainable by the

heater is dependent on the watt density of the heating element 10, the power available and the temperature characteristics of the encapsulating material.

A metal plate, typically of aluminium, may be secured to at least one of the major external surfaces of the moulding to increase the area over which heat is dispersed.

One method of making the panel will now be more particularly described with reference to Figures 2 and 3.

Firstly, referring to Figure 2, a sheet 16 of polyester moulding compound is laid on a suitable non-stick surface. The heating element 10 is then laid in position directly on top of the sheet 16 and the cable terminations 14 are located in a groove in the lower half of a two part cable retaining device 17 supported in a jig 18. A further sheet (not shown) of polyester moulding compound is then laid directly over the heating element 11 and pressed flat. The upper half (not shown) of the cable retaining device 17 is then located on the lower half thereof and the two halves of the cable retaining device are fastened together with screws. The purpose of the cable retaining device 17 is to prevent the insulation on the cable terminations 14 from becoming damaged by heat during the moulding process.

The device 17 may, therefore, be made of metal and it is important that it should abut the edges of the two sheets of moulding compound.

The assembly comprising the two sheets of moulding compound, the heating element 10 and the cable retaining device 17 is then placed into a compression moulding machine 20 (see Figure 3) and the mould is closed. Two spigots 21, only one of which is shown, in the lower part of the mould extend into holes 22 in the cable retaining device 17 and a spring loaded plunger 23 in the upper part of the mould bears against the upper surface of the retaining device 17, to positively locate the retaining device 17 and ensure that the mould cavity is closed.

After moulding, the aforesaid assembly is removed from the mould 20 and cooled. The cable retaining plate 17 is removed from the assembly and used, after cooling in cold water, for a subsequent moulding operation.

To ensure even flow of material in the mould, it may prove necessary to provide additional moulding material at appropriate positions on the outer surfaces of sheets of moulding compound. This can be done by laying strips of the moulding compound below the lower sheet 16 and on top of the upper sheet.

The panel need not be flat but could be profiled, such as is shown in Figure 4, to suit a particular application, this being made possible by the flexible nature of the heating element 10.

The panel can be of any desired colour and, if required, can have a decorative finish applied by spraying or silk screen printing

The heater is fully insulated and water proof enabling it to be immersed in a liquid or exposed to wet or damp environments. Also, by ensuring that no air is included in the panel, oxidation of the heating element 10 and the connections between the element 10 and the terminations 14 will be prevented, thus ensuring a long element life.

The heater described above can be used in any application requiring a constant source of heat. For example it has application in cabinet heaters (anti-condensation/anti-frost panels), fishpond heaters, under soil heaters, heated brewing pads, under desk heaters, aquarium and vivarium heaters, ceiling heaters, diesel tank heaters (especially for motor vehicles), incubators, plant and seed propagators, food heaters, railway point heaters, and heated electrical insulators.

In the case of ceiling heaters, these could look like, and be substituted for, selected ceiling tiles, particularly above work areas.

In the case of railway point heaters, these could include a metal slipper attached to one surface of the heater. The slipper could be coated in PTFE which is chemically etched to the metal.

The heater need not be in the form of a panel. It could be of any other appropriate shape, and may, for example, be in the shape of a vessel, such as is shown in Figure 5, or in the shape of a tube, such as is shown in Figure 6.

Referring now to Figures 7 and 8 of the drawings, the heating device shown therein comprises a casing 30 and a heater unit 31, which comprises a plurality of spaced apart heaters 32 (typically six in number), mounted in the casing 30. The heating device also comprises a fan 33 for drawing air in through an air intake opening 34 at the lower end of one side of the casing 30 and for causing that air to pass serially between adjacent pairs of heaters 32 before exiting through an air outlet 35 at the upper end of the casing 30.

Each heater 32 has a metal plate 36, typically

of aluminium, secured to each of its two major external surfaces to disperse heat over substantially the entire surface area of the heater. The heaters 32 are assembled into the unit 31 by threaded rods 37 which extend through aligned apertures in the heaters 32, by spacers 38 mounted on the threaded rods 37 between adjacent pairs of heaters 32, and by nuts 39 which co-operate with the ends of the threaded rods 37 to clamp the heaters 32 and the spacers 38 together.

Adjacent heaters 32 are staggered vertically with respect to one another, as best shown in Figure 8, and panels 40 of thermally insulating material are fixed to top and bottom of the heater unit 31 so as to extend over all but the foremost heater 32 at the bottom and the rearmost heater 32 at the top so that the spaces between each pair of adjacent heaters are connected together in series. The front, rear and two sides of the heater unit 31 are also preferably covered by panels of thermally insulating material.

The casing 30 is formed of aluminium and comprises an inner lower part 30a, which extends below and serves to support the heater unit 31 and to house the fan 33, and an outer part 30b which houses the heater unit 31 and which extends over and is secured to the lower part 30a, typically by rivets.

The top of the outer casing part 30b may be in the form of a hinged lid 30c which can be pivoted between a position as shown in Figure 8 in which it defines the air outlet 35 and a closed position when the heating device is not being used.

The heating device also comprises an on/off switch 42, an indicator light 43, a cable clamp 44, and a thermal cut-out device 45.

The heating device described with reference to Figures 7 and 8 is a space heater which will run off a 24 volt supply, typically drawing about 8 amps. It has particular application as a heater for the cab of a heavy goods vehicle which it can heat without difficulty.

The embodiments described above are given by way of example only and various modifications will be apparent to persons skilled in the art without departing from the scope of the invention as defined by the appended claims. For example, whilst it is highly desirable for the heating element to be flexible, it need not necessarily comprise a woven mat coated with resistive material. It could instead comprise any other appropriate electrically insulating substrate supporting resistive material or could be a resistive sheet such as

a mat formed from a single aluminum strand. Also, the copper ribbons could be replaced by any other appropriate conductive strips. Also, the heating element could be made up of two or more parts connected electrically in series.

CLAIMS

1. An electric heater comprising a heating element encapsulated in a rigid plastics moulding and means for connecting the heating element to a source of electricity externally of the moulding.

2. An electric heater as claimed in claim 1, wherein the heating element is in the form of a flexible sheet.

3. An electric heater as claimed in claim 1 or claim 2, wherein the heating element comprises a substrate of electrically insulating material, coated with electrically resistive material.

4. An electric heater as claimed in claim 3, wherein the substrate is in the form of a woven mat.

5. An electric heater as claimed in claim 4, wherein the mat is of woven glass-fibres.

6. An electric heater as claimed in any one of claims 3 to 5, wherein the electrically resistive material includes carbon particles.

7. An electric heater as claimed in claim 6, wherein the electrically resistive material is a

plastics material containing carbon particles.

8. An electric heater as claimed in any one of the preceding claims, wherein the heating element is disposed in the rigid plastics moulding adjacent to a major external surface of the heater.

9. An electric heater as claimed in any one of the preceding claims, wherein the encapsulating material is an impact resistant plastics moulding.

10. An electric heater as claimed in any one of the preceding claims, wherein a metal plate is secured to at least one of the major external surfaces of the rigid plastics moulding.

11. An electric heater substantially as hereinbefore described with reference to the accompanying drawings.

12. A heating device comprising a casing, a plurality of electric heaters according to any one of the preceding claims, mounted in spaced relationship in the casing, and means for causing air to pass over the electric heaters.

13. A heating device as claimed in claim 12, wherein there are at least three of said electric

heaters and the spaces between adjacent pairs of electric heaters are connected together in series.

14. A method of making an electric heater according to any one of claims 1 to 11, comprising the steps of:

(a) placing the heating element between two sheets of a moulding compound, and

(b) subjecting the assembly comprising the heating element and the two sheets of moulding compound to a compression moulding step.

15. A method as claimed in claim 14, wherein that part of the connecting means adjacent to, and not disposed between, the two sheets of moulding compound is protected from exposure to excessive heat during the moulding process.

16. A method as claimed in claim 14 or claim 15, wherein that part of the connecting means adjacent to, and not disposed between, the two sheets of moulding compound is contained within a metal retaining device during the moulding process.

17. A method as claimed in claim 16, wherein the metal retaining device is positively located in the mould during the moulding process.

18. A method of making an electric heater according to any one of claims 1 to 10, substantially as hereinbefore described with reference to Figures 2 and 3 of the accompanying drawings.

Patents Act 1977 18
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

(i) UK Cl (Edition K) H5H HBH

(ii) Int CL (Edition 5) H05B 3/28 3/30

Search Examiner
R W BALDOCK

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: CLAIMS, WPI

Date of Search
1 JUNE 1992

Documents considered relevant following a search in respect of claims

Category (see over)	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1454394	(NRDC) See especially Example 1	1, 2, 9
X	GB 1050386	(ICI) See especially page 1 lines 67-71, page 2 lines 86-96	1-9
X	US 4474841	(KEREKES) See especially column 1 lines 6-12 and Example 1	1-9, 14
X	US 4158078	(HUBBNER) See especially column 2 lines 16-64	1-9, 14
X	US 3968348	(STANFIELD) See especially column 2 lines 11-40	1, 8-10, 14

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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